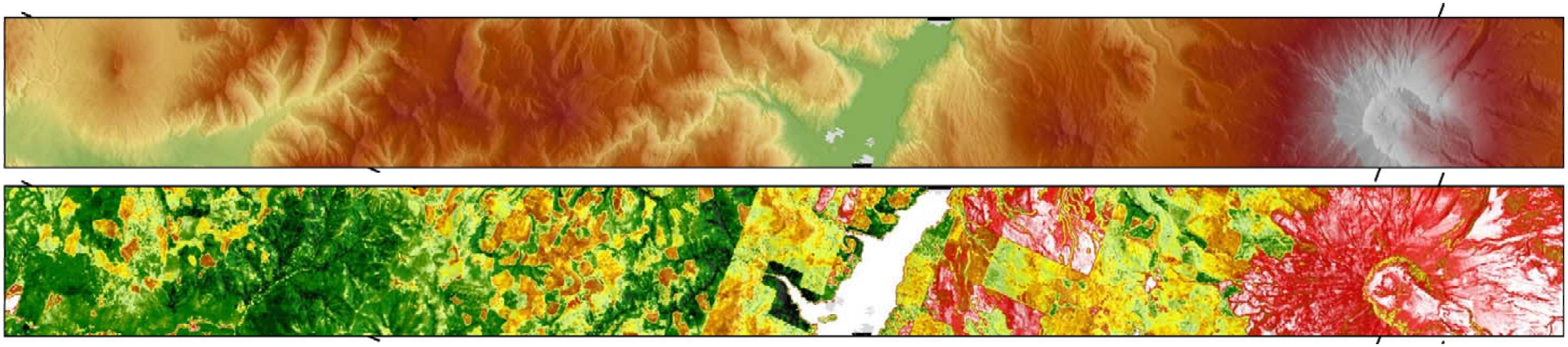
Future Use of NASA Airborne Platforms to Advance Earth Science Priorities

Surface Dynamics, Geological Hazards and Disasters



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Overview

- **Utility of airborne platforms for mapping surface topography and dynamics:**
  - **Science data collection**
  - **Cal/val and augmentation of space-based sensors**
  - **Pre-launch sensor and algorithm development for space-based sensors**
- **Long-range, high-altitude capability => regional and/or remote mapping**
- **Multi-sensor capability => contemporaneous observations**
  - **Miniaturization of sensors -> sensor investment?**
- **Optimizing high-altitude long-range platforms**
  - **Smart mission planning – weather and sensor compatibility**
  - **Spatial resolution to meet community goals -> sensor investment**

Role of Airborne Observations in Path to Space

- Collect example data sets to refine requirements for space-based sensors
  - Evaluate spatial resolution, coverage and temporal sampling strategies
  - Optimize requirements – so not building too little/too much (the "Goldilocks" sensor)
    - The Surface Topography and Vegetation (STV) Targeted Observable wants 1-5m spatial (0.1m vertical) resolution lidar – finer resolution can be exponentially harder to implement from space
- Supports science and real-time algorithm development
  - Develop techniques to efficiently collect and extract information from future space sensors
- Provide opportunity to test and mature candidate components and technologies
  - Multi-port airplanes could also provide tag-along opportunities for Early-career engineers/scientists to mature next generation technologies
- Lastly, could an airborne platform be part of a holistic solution to Decadal goals?
  - Could this eliminate a challenging case that makes space-based lidar implementation easier?

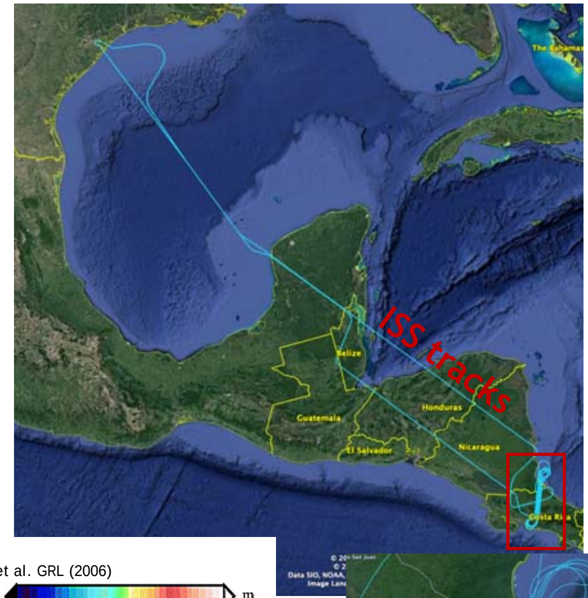
Multi-Sensor Capability

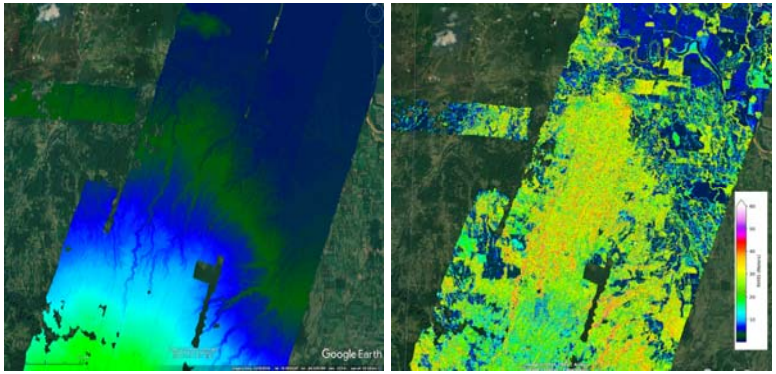
- Platforms such as DC-8, G-V, P-3 provide cabin space and multiple ports to fly multiple sensors simultaneously
- Flight efficiencies are lost if sensors aren't compatible in terms of pointing angles, swath width, altitudes, required lighting conditions, etc.
  - Smart flight patterns can be designed to achieve sensor overlap
  - Can we miniaturize sensors so we can fit more? - on the G-V, for example

- Other communities have approached this by flying multiple sensors on multiple planes along common flight lines (e.g., ABoVE and OIB)
  - Allows optimization of aircraft capabilities for each sensor

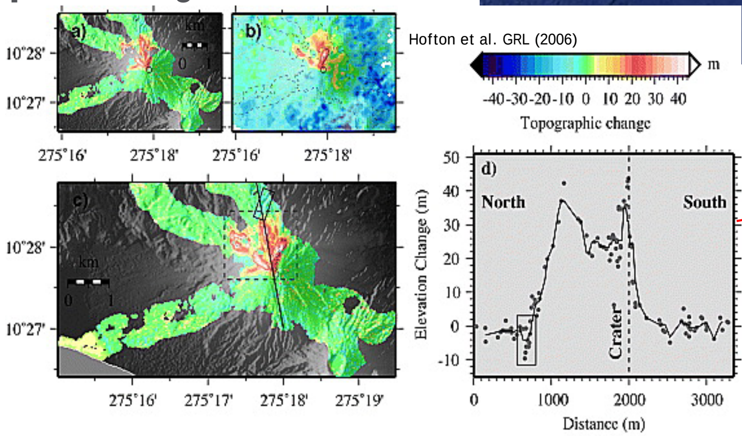
Benefits of Long-Range, High-Altitude Capability

- **Long-range enables access to multiple, geographically-diverse targets, expands accessible area, and provides ability to loiter**
- **Having a wide range of targets lets you chose best weather/ follow the cloud-free areas (important for optical sensors)**
- **Example: Houston-based/Costa Rica flight on the G-V in 2019**
  - **While waiting for good weather, LVIS was collecting US-based cal/val data for GEDI, then deployed for 12hr flight to Costa Rica when clear**
  - **Allowed us to avoid international travel and simplified logistics**

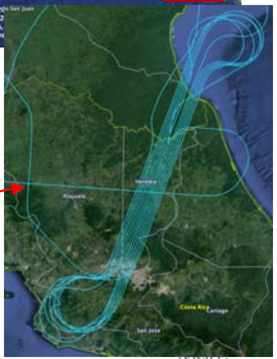




Topo and Height Maps for GEDI cal/val and AGBD

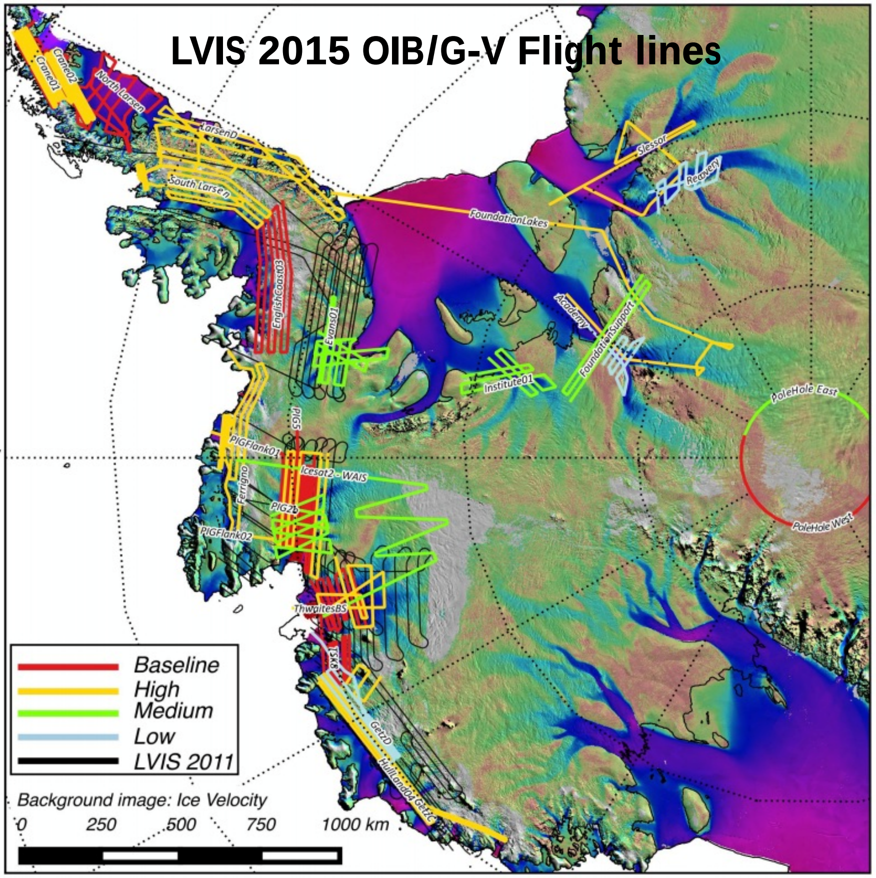


Effusion rates @ Arenal Volcano from waveform lidar

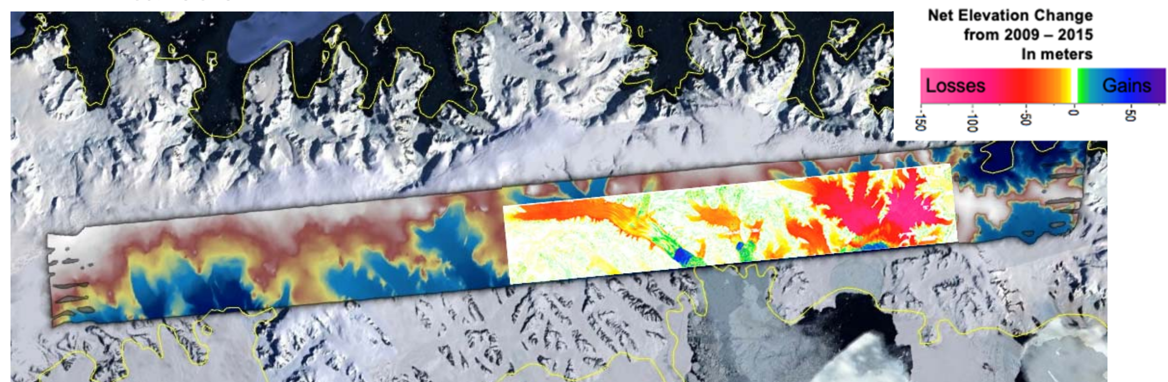


GEDI
ECOSYSTEM LIDAR

Geographically-Diverse Mission Targets



- OIB/LVIS – DC8 (2009) and NSF G-V (2011, 2015)
- Successful mapping of ~95% of target areas in a location that's considered persistently cloudy by:
  - Having geographically-diverse targets that provided multiple options each day
  - Good weather prediction tools (GMAO, ECMWF, GFS)
  - Follow the weather - stay in contact with aircraft during transits and replanned if necessary
  - Lidar mapped 150,000km² in 2015 LVIS deployment to Antarctic



Glacier and ice sheet mapping and change detection with LVIS